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troscopic observations at Greenwich seem to show that *Sirius* recedes from us at one time with a velocity of about twenty-two miles per second, and at another time is coming towards us at the same rate, as it moves in an elliptic orbit.

Certain minute changes in the motions of this brightest of the stars induced BESSEL, the famous astronomer of Königsberg, to suspect the existence of some, as yet unseen, companion sun, whose disturbing influence might account for the unusual displacements. AUWERS, another astronomer, calculated the probable elements of this unseen disturbing mass. Ultimately, a companion star was discovered by Mr. ALVAN G. CLARK (maker of the object-glass for the great LICK telescope), by means of the refractor of 18½-inch aperture made by himself. This excellent instrument now belongs to the Observatory of Northwestern University. The companion, though at least one-tenth as heavy as *Sirius* itself, can only be seen under favorable conditions, for its light is not more than one-12,000th part of that emitted by *Sirius*.

THE PROPER MOTIONS OF STARS WITH DIFFERENT SPECTRA.

By W. H. S. MONCK.

Having recently examined M. BOSSERT's catalogue of stars with proper motion of 0″.5 annually, with the spectra of such as I could identify in the DRAPER catalogue, I think the result worth giving, especially as the spectra of the remainder can be tabulated according as they are examined. M. BOSSERT'S catalogue sometimes includes two members of a binary system and in other places two determinations of the proper motion of the same star (occasionally disguised by giving it a different designation). Duplicates of this kind can be detected when the stars are arranged in order of R. A. instead of by the magnitude of their proper motions, and this order will, I think, also bring to light the fact that the motion of the sun in space affects the apparent proper motions of the stars more largely than is commonly supposed. Assuming the R. A. of the sun's *goal* to be 280°, its motion will tend to diminish the Right Ascensions of all stars between 100° (6^h 40^m) and 280° (18^h 40^m) and to increase the Right Ascension of all stars between 280° and 100°. It will also tend to increase the N. P. D. of all stars save those situated between the *goal* and the North Pole on the one hand and those between the *quit* and the South Pole on the other. Very evident traces of this will be found in the following table. The places are those for 1890. The proper motion in R. A. is in seconds of time.

No.	Name.	Spectrum.
1.	β Cassiopeia	F
2.	248 Lal	—
3.	ζ Toucan	—
4.	475 Lal	—
5.	β Hydra	—
6.	147 Lac	F
7.	999 Lal	E
8.	54 Pisces	H
9.	172 Lac	—
10.	1045 Lal	—
11.	1065 Lal	H
12.	1198 Lal	—
13.	η Cassiopeia	F
14.	189 Piazzi 0^h	H?
15.	μ Cassiopeia	H
16.	1964 Lal	—*
17.	1966 Lal	—
18.	ν Phœnix	—
19.	2387 Lal	—
20.	2450 Lal	H
21.	2635 Lal	—
22.	2682 Lal	—
23.	2966 Lal	—
24.	3022 Lal	—
25.	υ Andromeda	F
26.	107 Pisces	F
27.	τ Cetus	G?
28.	159 Piazzi 1^h	—†
29.	χ Eridanus	—
30.	3277 Bradley	—
31.	δ Triangulum	F
32.	4141 Lal	—
33.	4268 Lal	E‡
34.	123 Piazzi 2^h	H
35.	4855 Lal	H
36.	5490 Lal	—
37.	ι Perseus	F
38.	12 Eridanus	F
39.	113 Weisse	—
40.	6108 Lal	—
41.	1060 Lac	—
42.	3^1 Reticulum	—
43.	3^2 Reticulum	—
44.	6320 Lal	—
45.	6429 Lal	—
46.	ε Eridanus	K
47.	10 Taurus	F
48.	6788 Lal	—
49.	6772 Lal	H
50.	δ Eridanus	I
51.	6888 Lal	—
52.	τ^6 Eridanus	F
53.	735 Groomb	—
54.	7443 Lal	—
55.	7653 Lal	F
56.	o^2 Eridanus	H?

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* The DRAPER *Catalogue* gives a star at 1° 4′ + 22° 23′ with a doubtful spectrum A.

† Two stars near this point, one with spectrum A and the other G? Neither probably identical.

‡ Identification doubtful. LALANDE makes the star fainter than in the D. C.; same remark of No. 35, and some others, but LALANDE'S magnitudes are usually less than the photometric.

No.	Name.	Spectrum.	No.	Name.	Spectrum.
57.	8375 Lal	—	88.	15547 Lal	—
58.	9011 Lal	—*	89.	15565 Lal	—
59.	9012 Lal	A	90.	15950 Lal	E
60.	π^1 Orion	F ? †	91.	321 Piazzi 8^h	— ||
61.	1189 Weisse	—	92.	181 Weisse$_2$	—
62.	m Taurus	E	93.	16304 Lal	E
63.	λ Auriga	F	94.	3386 Lac	—
64.	9960 Lal	—	95.	17161 Lal	—
65.	9986 Lal	H?	96.	1384 Fedorenko	—
66.	61 Piazzi 5^h	—‡	97.	ρ^2 Cancer	H
67.	10299 Lal	—§	98.	ι Ursa Major	A
68.	990 Groomb	—	99.	10 Ursa Major	F
69.	146 Piazzi 5^h	I	100.	18067 Lal	—
70.	10797 Lal	—	101.	81 Cancer	H
71.	2138 Lac	—	102.	18115 Lal	H
72.	δ Lepus	I	103.	θ Ursa Major	F
73.	11196 Lal	—	104.	11 Leo Minor	H
74.	2106 Lac	—	105.	19022 Lal	—
75.	1159 Groomb	F	106.	20 Leo Minor	A ?
76.	Sirius	A?	107.	1643 Fedorenko	H
77.	2501 Lac	—	108.	γ Leo	K
78.	13427 Lal	—	109.	1646 Groomb	A ?
79.	305 Piazzi 6^h	E?	110.	1688 Fedorenko	—¶
80.	13849 Lal	E?	111.	520 Weisse	—**
81.	14146 Lal	—	112.	α Crater	I ?
82.	2740 Lac	—	113.	21185 Lal	—
83.	Procyon	F	114.	21258 Lal	—
84.	Pollux	K?	115.	469 Mayer	E
85.	1339 Groomb	I	116.	ξ Ursa Major	G
86.	2957 Lac	—	117.	32 Piazzi 11^h	—††
87.	15290 Lal	—	118.	11677 A. O.	—

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* A star near this point with spectrum H.

† This seems to be the star designated π^1 *Orion* in the *Harvard Photometry*. I have given its spectrum accordingly.

‡ The position is vcry near 23 *Orion* (spectrum A) but the magnitudes differ considerably.

Perhaps identical with D. C. No. 3089, spectrum H.

|| This seems to be the same star as the foregoing. One determination is from the Seven Year Catalogue and the other from Paris Observations.

¶ Apparently the same star as the foregoing. One determination is from the A. N. and the other by ARGELANDER.

** This star does not seem to be identical with D. C. No. 5436, spectrum F.

†† Probably not identical with D. C. No. 5689, Spectrum H ?

No.	Name.	Spectrum.
119.	83 Leo	I
120.	20 Crater	—
121.	22069 Lal	F
122.	1822 Groomb	—
123.	4887 Lac	—
124.	β Leo	A
125.	β Virgo	G
126.	1830 Groomb	A?
127.	4955 Lac	—
128.	22585 Lal	— *
129.	22632 Lal	A†
130.	22701 Lal	—
131.	69 Weisse	—
132.	22908 Lal	—
133.	22954 Lal	E
134.	22986 Lal	—
135.	8 Can. Ven.	F
136.	γ Virgo	F
137.	33 Virgo	H
138.	23806 Lal	—
139.	23917 Lal	—
140.	23995 Lal	—
141.	δ Virgo	M‡
142.	24168 Lal	—§
143.	24414 Lal	H
144.	42 Coma	F
145.	43 Coma	F
146.	24504 Lal	—
147.	61 Virgo	H
148.	241 Weisse$_2$	A
149.	216 Weisse	—
150.	24774 Lal	—
151.	70 Virgo	F
152.	25012 Lal	—
153.	ι Centaurus	—
154.	25372 Lal	—
155.	25404 Lal	—
156.	τ Boötes	F
157.	25484 Lal	—
158.	θ Centaurus	—
159.	Arcturus	K
160.	26289 Lal	H?
161.	26630 Lal	E
162.	127 Piazzi 14^h	—‖
163.	α_1 Centaurus	—
164.	α_2 Centaurus	—¶
165.	728 Weisse	—
166.	27026 Lal	—
167.	212 Piazzi 14^h	—
168.	27298 Lal	—
169.	27274 Lal	—
170.	D M 2874 + 25	—
171.	14318 A. O.	—
172.	14320 A. O.	—**
173.	27744 Lal	—††
174.	5 Serpens	F
175.	268 Weisse	—
176.	28607 Lal	—
177.	β Tr. Aus.	—
178.	39 Serpens	—
179.	χ Hercules	F
180.	γ Serpens	F
181.	49 Libra	—
182.	ρ Corona Bor.	F

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* Does not seem to be identical with either D. C. No. 5972 or No. 5992.

† Identification (with 67 Ursa Major) doubtful.

‡ This is the only star in the list with a spectrum of the third type. Its proper motion is only $0''.50$ annually.

§ This is the only case in which a star occurs twice in M. BOSSERT'S list under the same name.

‖ Seems to be identical with the foregoing star. The former determination is by ARGELANDER and the latter from A. N.

¶ Binary companion of the foregoing. Proper motions no doubt really agree.

** Perhaps a distant binary companion of the foregoing.

†† Perhaps identical with D. C. No. 6939, spectrum H.

No.	Name.	Spectrum.
183.	29437 Lal	—
184.	18 Scorpion	F?
185.	30024 Lal	—
186.	30044 Lal	—
187.	3 Hercules	G
188.	ε Scorpion	—
189.	30694 Lal	—
190.	31055 Lal	—
191.	31132 Lal	—
192.	36 Ophiuchus	I
193.	9383 Stone	—*
194.	30 Scorpion	—
195.	72 Hercules	E
196.	322 Weisse	—
197.	32047 Lal	H †
198.	514 Weisse	—
199.	26 Draco	F
200.	17415 A. O.	—
201.	μ Hercules	I?
202.	1005 Weisse	—
203.	70 Ophiuchus	K
204.	η Serpens	K
205.	χ Draco	F
206.	34986 Lal	—
207.	36245 Lal	H
208.	b Aquila	H
209.	2459 Bradley	H
210.	8139 Lac	—
211.	36872 Lal	— ‡
212.	3205 Fedorenko	H
213.	σ Draco	I?
214.	Altair	A
215.	8262 Lac	—
216.	38100 Lal	—
217.	38139 Lal	—
218.	δ Pavo	—
219.	38380 Lal	H
220.	38383 Lal	—
221.	8362 Lac	—
222.	8381 Lac	—
223.	38692 Lal	— §
224.	3436 Fedorenko	E?
225.	20452 A. O.	—
226.	802 Weisse	—
227.	39816 Lal	—
228.	39866 Lal	—
229.	40215 Lal	—
230.	η Cepheus	K
231.	8620 Lac	—
232.	3638 Fedorenko	A
233.	1454 Weisse	—
234.	40849 Lal	—
235.	61^1 Cygnus	H
236.	61^2 Cygnus	— ‖
237.	97 Weisse	—
238.	3738 Fedorenko	—
239.	τ Cygnus	F
240.	41363 Lal	—
241.	21319 A. O.	—
242.	γ Pavo	—
243.	8960 Lac	—
244.	42883 Lal	—
245.	ε Ind	—
246.	43205 Lal	—
247.	9061 Lac	—
248.	43492 Lal	A?
249.	ν Ind	—
250.	ξ Pegasus	F

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* Same as foregoing with identical determinations by AUWERS and STONE.

† Identification doubtful. D. C. gives same place for 1900 as BOSSERT for 1890.

‡ Same as foregoing star.

§ Probably same as foregoing but the determinations are discordant. The first is from the A. N. and the second by ARGELANDER.

‖ Probably a binary companion of the foregoing star with identical proper motion. The spectrum is that of the pair.

No.	Name.	Spectrum.
251.	σ Pegasus	F
252.	44964 Lal	—
253.	9352 Lac	—
254.	4371 Fedorenko	—
255.	3077 Bradley	H
256.	45455 Lal	—
257.	γ Pisces	I
258.	45599 Lal	—
259.	9537 Lac	—
260.	ι Pisces	F
261.	46495 Lal	H
262.	9585 Lac	—
263.	46650 Lal	—
264.	23166 A. O.	—
265.	85 Pegasus	E
266.	32416 Cordoba	—

It is perhaps too soon to draw results from a table so incomplete as the foregoing. It, however, suggests the following conclusions: First, the sun is one of a cluster of stars distinguished from the others by their vicinity and large proper motion and also by the great preponderance of stars whose spectra are of the second or solar type. This cluster also includes a very large proportion of binary stars whose orbits are capable of computation. Second, while the motions of the stars in this cluster afford very strong evidence of the sun's motion in space, the effect in R. A. is greater and the effect in N. P. D. less than when we examined the proper motions of stars not belonging to the cluster; whence it would seem that the cluster has a northerly drift in space, thus making the direction of the sun's *goal* apparently less northerly than its true position. The cluster probably contains many more stars than those comprised in the foregoing list; for besides faint stars with large proper motion which have hitherto escaped detection it must be recollected that in certain parts of the sky a very small motion opposed to that arising from the sun's motion may be equivalent to a very large one in the opposite direction. In the one case we are dealing with the difference of two motions; in the other, with the sum. The table indicates this plainly. Only five stars occur between 6^h and 7^h, the R. A. of the sun's *quit*, and only three between 18^h and 19^h, the R. A. of his *goal*, and in none of these cases save *Sirius* does the proper motion amount to $1''$ annually. The sun's motion is very probably a combination of the drift of the cluster with an orbital motion round some point in the cluster.

(For readers who have not seen the DRAPER catalogue I may mention that the letters A to D inclusive represent varieties of the first type of spectrum, E to L inclusive varieties of the second type and M the third type.)

P. S.

16 Earlsfort Terrace, Dublin,
March 14, 1892.

Dear Sir: Since sending you my last paper on the proper motions of the stars I arrived at some results which I think may interest you and may lead to further inquiries at the Lick Observatory and elsewhere.

The second or solar class of stars are divided in the Draper catalogue and elsewhere into several subdivisions. There are two of these which I would propose to distinguish as Capellan and Arcturian from the principal stars belonging to them. The Capellan include E and F of the Draper catalogue, the Arcturian H, I, K and L, with perhaps G, but I am not sure of its position. My conclusion is that the Capellan is the prevalent type among the *nearer* stars and that it is so in a very marked degree.

Taking Mr. Gore's list of double stars with computed orbits (the computability of an orbit I take to be strong evidence of comparative nearness), there are about 20 Capellan stars out of some 43 or 44 which are also found in the Draper catalogue. They outnumber the *Sirians* which are a much more numerous class and are about three times as numerous as are the Arcturians which are at least as numerous over the whole sky, I think much more so. I made a further comparison with Mr. Main's catalogue of stars with large proper motion which I take to be further evidence of vicinity. Taking 0″.1 per annum as the limit and comparing Main's catalogue with the Draper catalogue I found that 24 per cent. of the *Sirian* stars were over this limit, 36 per cent of the Arcturian (and about the same proportion for stars of the third type which I may perhaps call Antarian), and 65 per cent. of the Capellan. As the stars became fainter the difference appeared to become more strongly marked. It almost seems as if the sun was one of a cluster of Capellans with only a stray intruder of any other spectrum. I disregarded the (?) in the Draper catalogue when classing the stars. In the paper which I sent I believe it would appear that there is a great preponderance of Capellan stars if we allow for their comparative paucity over the entire sky, but I have not as yet made out the exact figures to indicate this. They do not, I think, exceed 20 per cent. of the stars on the whole, if they amount to that, but I suspect that more than one-half of the nearer stars possess this type of spectrum.

I remain, sincerely yours, W. H. S. Monck.